

S.M. 23.2.1879

THE GREAT

ATLAS MOTH

OF ASIA

(*ATTACUS ATLAS*, LINN.):

WITH A

Coloured Plate of its Transformations.

BY

PHILIP HENRY GOSSE, F.R.S.

LONDON:

WEST, NEWMAN & CO., 54, HATTON GARDEN, E.C.

—
1879.

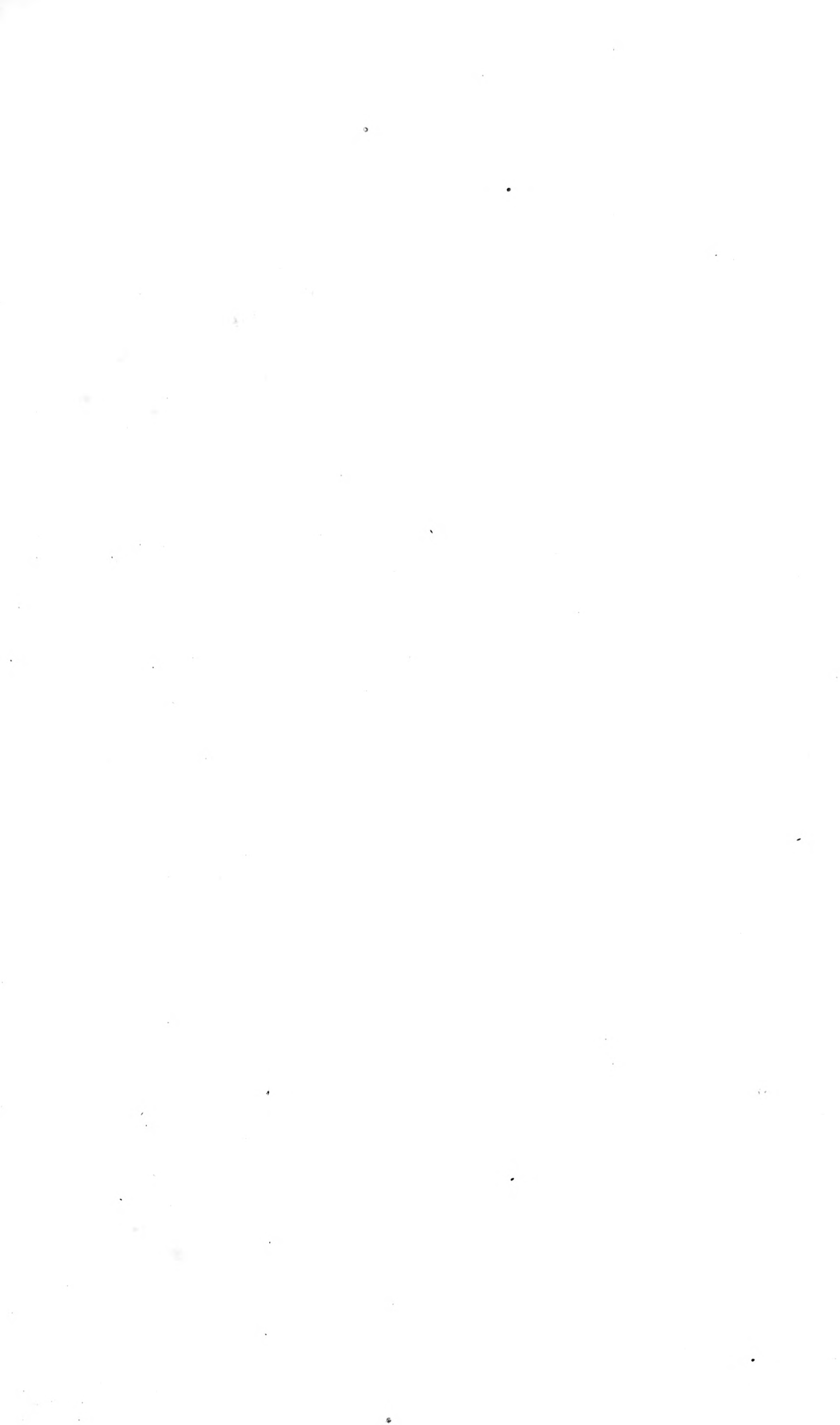
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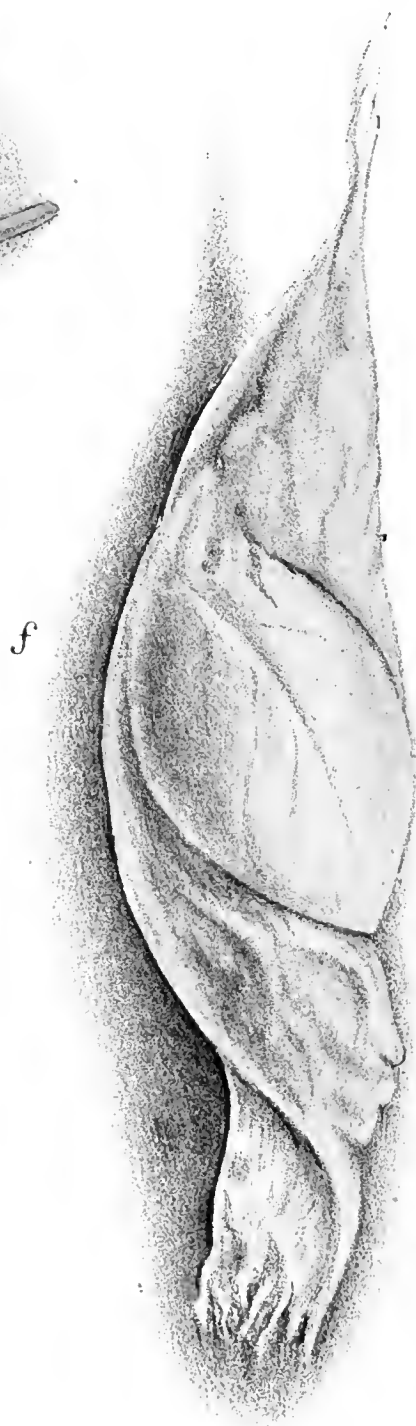
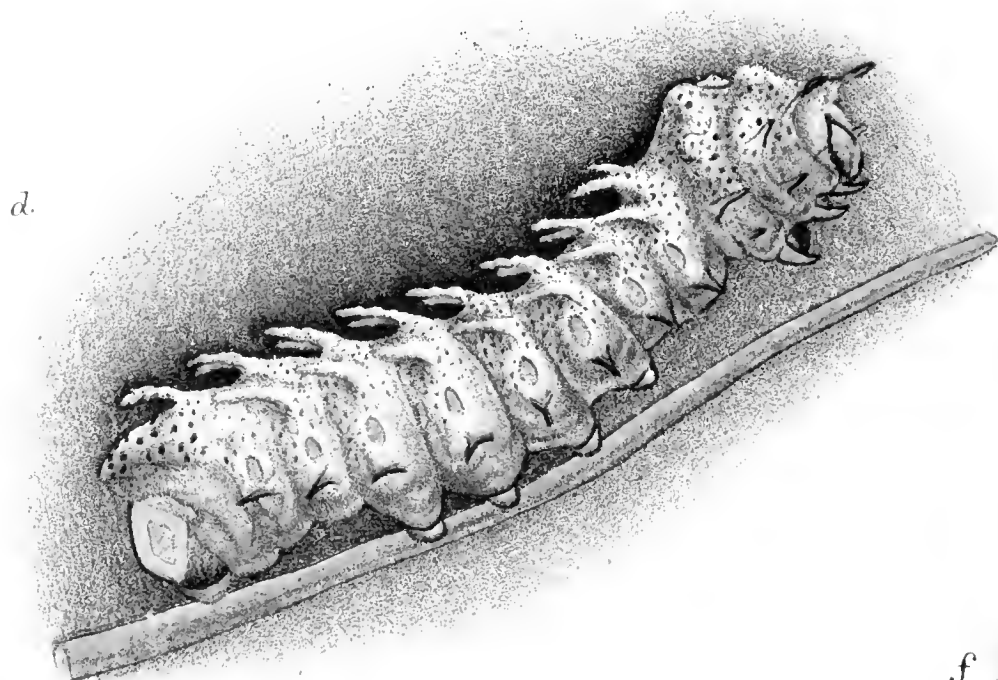
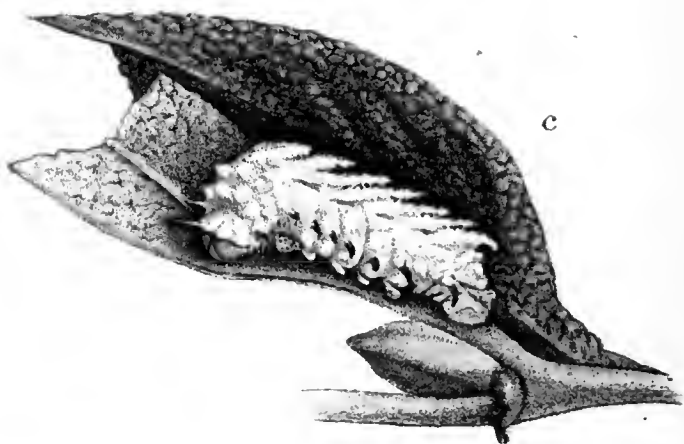
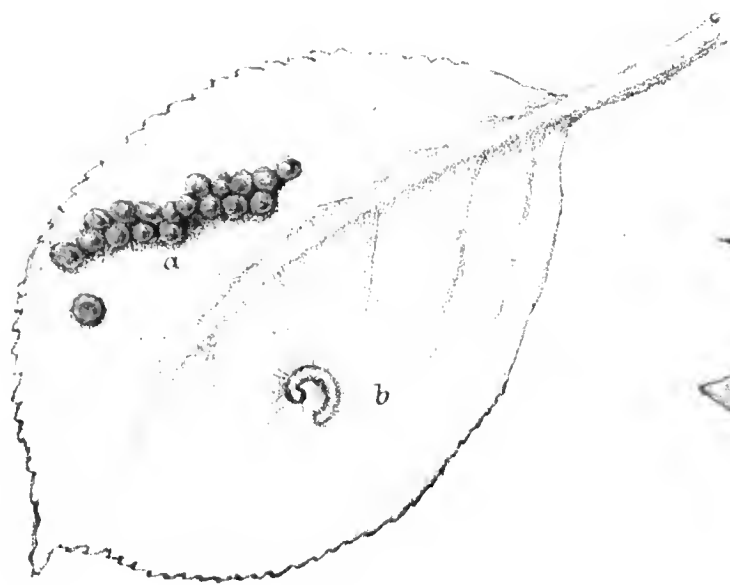
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R. B. Freeman

S. M. Edwards. K. S.

from
his dear Mother





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EXPLANATION OF THE PLATE.

Fig. *a*.—Eggs of *Attacus Atlas*.

Fig. *d*.—Larva in sixth age.

Fig. *b*.—Larva in first age.

Fig. *e*.—Pupa.

Fig. *c*.—Larva in fourth age.

Fig. *f*.—Cocoon.

All of natural size.)

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ATTACUS ATLAS: A LIFE-HISTORY.

BY PHILIP HENRY GOSSE, F.R.S.

THE Great Atlas Moth of farther Asia, the vastest of all known Lepidoptera, has always, with me,—at least since I began to collect and study Insects, now more than six and forty years ago,—been invested with a halo of romance; and to rear it through its various stages,—egg, caterpillar, pupa, imago,—this seemed too grand a vision to come within the range of hope, if hope is truly defined as desire with expectation. There was the desire, indeed, but the expectation was *nil*.

When I returned to England from America, in 1839, I saw, hawked about in the streets of London, (what doubtless my readers have often seen, for it is common enough, as I afterwards found),—a case of Chinese insects. A box, lacquered, and gilded, and glazed, crammed as full as it could hold, with insects of all Orders, and in the midst a noble *Attacus Atlas*, in perfect condition, a female stretching more than nine inches in expanse of wing, of the variety γ of the Brit. Mus. Catal. p. 1219. That very specimen I still possess. I bought the whole case, threw away the herd of plebeian beetles and bugs, retaining only a few of the finer *Papilionidæ* as satellites to *Atlas*, re-papered and re-furbished the box, making it hermetically tight, with such success that the lapse of forty years has not produced the slightest trace of mite-dust on the paper beneath the heavy-bodied Moth. Barring a little fading of the rich red and brown hues, the specimen is as perfect as it was then.

I do not mean to represent the acquisition of this example as any special achievement in science; it was but to myself the first incident in the history which I come to narrate. Even then the

species was common enough in all museums and private collections. It had been described by Linnæus, Fabricius, and Gmelin; pictured by Petiver, Seba, Valentin, Knorr, Merian, Cramer, Olivier, Hübner, and others;—so that no exotic insect was better known than “Le Géant des Papillons.” It is, too, a wide-spread species, ranging over the south and east half of Asia, continental and insular;—common on the slopes of the Himalayas, and all through India to the points of both peninsulas; abundant in China, as I have already intimated; scattered over the isles of the Archipelago, from Java to the Moluccas, to Borneo and the Philippines:—a range of 35° of latitude, and 55° of longitude.

As is often the case with animals of extensive habitat, this magnificent Insect is subject to considerable variety. The variations range in two groups, according as the curious windows in the wings are single, or accompanied by small side-windows. The possession of these glassy areas, of definite forms, and usually set in dark frames, is highly characteristic of the *Saturniadae*, the noblest family of the Moths; in some, indeed, reduced to little more than a mere slit of glassy membrane, as in our English Emperor Moth (*Saturnia carpini*), the only native example of the family; but in many taking large dimensions, and remarkable forms, whence these Moths are called by the French *Porte-miroirs*. Few have these windows more conspicuous* than the grand species before us.

Common as *Attacus Atlas* has been in all the museums of Europe for more than a century, our familiarity with it has been limited to its adult, imago condition: we have known it very well as a Moth; but, in other respects, not at all. What were the earlier stages of this noble insect? That the caterpillar would be *generally* like that of our own Emperor, we might confidently conjecture from analogy; that it would spin a cocoon of silk in which it would pass its pupa-life, there could be no doubt; but the dimensions, colours, and forms, of these, in detail, no one knew, in Europe at least. Some light irradiated the subject,

* In two species figured and described by Mr. Westwood in Proc. Zool. Soc. Lond. for 1849 and 1853,—*Attac. Mythimnia* of Port Natal, and *Att. Zacateca* of Bogota, the fenestræ are larger in proportion than in *Atlas*, though the insects themselves are much smaller; the latter of the two being indeed a tiny *Attacus*, though most elegant in form and rich in colour.

about twenty years ago; when Dr. T. Horsfield and Mr. F. Moore published two vols. of 'A Catalogue of the Lepid. Ins. in the Mus. of the E. Ind. Comp.' In the second vol. of that fine work, a full synonymy of the species is given; a description of its transformations by Lady Isabella Gilbert; and a note of its habits in Java. Lady I. Gilbert, in N. India, writes (1825):—

“A specimen (female) was caught on the 4th of September. On the following morning she laid several pink-and-white eggs. On the 15th the young caterpillars were hatched. Being uncertain what plant they fed on, I placed them on slips of different trees, viz., apple, plum, peach, &c. The young caterpillars were black, with numerous white spines; as they grew larger, and changed their skins, the spines became covered with a kind of white powder, giving them a very delicate appearance; added to which, the ground-colour of the body, since the first few days after they were hatched, had become a light green. They always ate their skins after casting them. Day and night they devoured the leaves, and those on the apple-branch grew to an enormous size: on the 12th of October one of these began to prepare for its transformation by bending back a large leaf, and inclosing itself in a web, which it completed on the 13th. During the three preceding days it had considerably diminished in size: this I have observed to be the case with many larvæ prior to their change. On the 22nd of June following the moth came out.”

To this the authors have added:—“Feeds on the Melokka *Phyllanthus emblica*), Kupu-gaja, &c. December to January. Rather common. (Horsfield MS.)” The full-grown larva and the cocoon are figured from the last-named authority.

In a valuable “Synopsis of the known Asiatic species of Silk-producing Moths,” (Proc. Zool. Soc. for 1859), Mr. Moore has, of course, included *Att. Atlas* (p. 265). The account in the ‘Catalogue’ is repeated verbatim, with the following additional note. “It is said that the Chinese Tusseh silk is obtained from the cocoon of this species.”

Mr. F. Walker (List of Lep. Ins. in B. Mus. Part V.—1855) gives, besides a copious synonymy, a diagnosis of eight varieties of the imago; but not a hint of the early stages.

The mortality which has, during the last quarter of a century, fallen on the cultivated Silkworm, not in Europe only but also throughout Asia, has caused an anxious search in various countries for other silk-spinning species, and the introduction of several of these into Western Europe; in hope that some might

prove available substitutes for the long established *Bombyx mori*; or, at least, valuable aids to it. The success of these endeavours it is not my present business to exhibit; they have certainly not been wholly futile; suffice it to observe, that among these importations the cocoons of the glorious *Atlas* have at last gladdened our occidental eyes.

In March 1868 M. Braine, of Arras in France, received thirty cocoons of *Atlas* from that learned entomologist Captain Thomas Hutton of Mussooree, whose researches on the debilitated condition of the old Silkworms, and suggestions for their renovation, are well known (Trans. Ent. Soc. 1864, 1865). M. Braine has given us* a brief relation of his success in rearing the species. The cocoons being kept dry, in July evolved the moths, seven and a half to nine and three-quarter inches in expanse. Through the irregularity of their emergence, coupling was accomplished with difficulty, and only a few (fifty or sixty) ova were produced, which were of a rose-colour, and not quite so large as those of *Yama-mai*. These he wintered in a warm room; and the larvæ were hatched about the end of the following June (1869). He fed them on the common pink barberry, in the open air, exposed to the sun. Many of them died at the third moult; more still at the fourth. At last, however, a few went into cocoon, towards the end of August; these were exhibited to the public at the Exposition des Insectes (Oct. 1872). This time the marriages of his pets were much more normal, and he obtained a considerable number of eggs, and some "very remarkable" moths. He hoped now to prosecute his culture on a large scale. But the war in 1870 blasted his hopes, wasted his plantations, and just permitted him, with difficulty, the means of recommencing. Having replanted his barberries, and nursed his protégés, M. Braine obtained in 1872 a full success, and exhibited satisfactory results at the Exposition of Luxemburg.

"I think I may say," concludes the enterprising naturalist, "that I have acclimated this magnificent species of Bombycide, of which each cocoon weighs, on an average, two grammes [or $\frac{1}{14}$ th of an ounce]."

"The *Attacus Atlas* is very inert and somnolent: when once it is attached to the tree, it is, so to speak, glued to it, and does not fall like *Yama-mai*. It is very fond of water; thrice a day I gave the worms a fine and soft rain, which always revived them. The fourth moult is the most

* *L'Attacus Atlas*, le géant des Papillons; son introd. en France, par M. A. Braine et Maurice Girard.

perilous: a scarcely perceptible black speck appears under the last segment, and spreads so that in two days the caterpillar is wholly changed in colour, and decomposed. . . . The silk is of the same colour as that of *A. Cynthia*: it is very strong and brilliant. I have not been able yet to attempt the winding, but hope to report on this shortly."

I am not aware that this hope was ever fulfilled; nor that the world has heard any more of M. Braine's experiments. To his Memoir, which was originally published in the Bulletin of La Société d'Acclimatation, June 1873, M. Maurice Girard, the able and learned Secrétaire du Conseil, appended a *Note Entomologique*. In this we find a very valuable epitome of the genus *Attacus* (=Fam. *Saturniadae*), and of *Atlas* in particular; so far as they were known up to that time. On the early stages of the species he has nothing to present except the note of Lady I. Gilbert, which he translates from Horsfield and Moore. He gives a description of the adult larva, but this is manifestly drawn up from the figure of the English naturalists, *not from the life*.

The closing remark of Dr. Girard is worthy of citation:—

"It is worth observing that this species, in those hot regions, behaves like *S. pyri* and *carpini* with us. The eggs hatch soon after they are laid; and the long latent life is that of the pupa. On the contrary, with M. Braine, it is the eggs which endure longest, as with the common Silkworm and the *Yama-mai*. This seems to point to a colder climate, and perhaps indicates the race as being from the Himalaya."

The first living examples of *Attacus Atlas* seen in this country, that I have been able to hear of, were a dozen living cocoons in the possession of Mons. Alfred Wailly, of 110, Clapham Road, Memb. and Laureate of the Soc. Acclim. of Paris, and author of several interesting Memoirs on the Culture of Silk-producing insects. These cocoons had been imported direct from India, early in the year 1877; but not by M. Wailly himself, and he is not able to trace the exact locality, but believes that they came from the slopes of the Himalayas. It is remarkable that no Moth emerged from these cocoons during the whole year 1877, so wet and cold; but, in July 1878, imagines were evolved of both sexes, which proved to be a variety of unusual richness and brilliancy of colour, as well as of unusual dimensions;—one female, as M. Wailly assures me, measuring ten inches and a half in expanse. It is most unfortunate that he was unable to obtain any marriage of this race.

Meanwhile, in the spring of 1878, two hundred cocoons were imported from Bangalore, in South India, by Mr. Wm. Watkins of 36, Strand. Of these, fifty were purchased by Mr. Wailly, but the majority of the importation were (as I learn from Mr. Watkins), allowed to emerge* in order to procure a stock of ova, which afterwards he largely distributed.

Of these cocoons, two came into my possession, one from M. Wailly, on the 5th of May, the other from Mr. Watkins, a month later. The latter was the first to emerge.

Early in the morning of July 26th, I had the pleasure of seeing, hanging within the glass door of my cocoon-cage, a male of great beauty, and in high perfection. It differs much in form and colours from my old China specimen. It is very dark and rich in hues,† one-windowed; apparently the var. *n* of the Catal. Lepidopt. Br. Mus.; Heterocera, p. 1219.

* "So successful was I that I had only four bad cocoons, and *not one cripple*. I found, however, that, unlike most *Saturniadae*, they were not easily paired: in several instances, the sexes, though placed together when freshly evolved, refused to copulate. Some indeed did, for a few hours: others were united for twenty-four hours: yet from these I procured *no fertile eggs*. The only eggs that hatched were females that had been in copulâ for forty-eight hours." (Mr. Watkins in litt.)

+ This specimen is quite worthy to be compared for beauty with that one described and figured by Mr. Adam White, as a distinct species, by the name of *Att. Edwardsii*. I know it, indeed, only by the diagnosis, description, and figure in the Proc. Zool. Soc. (1859, p. 115, pl. Annul. lvii.); the author has omitted to say where any type-specimen is preserved. The chief points of difference between mine and this species (?) are the following: the fenestræ have the longest angle pointing, in mine, towards the base, in *Edw.* towards the point, of the wings: they are margined with yellow in *Edw.*, of which, in mine, there is no trace. The white bands are wider: the black hue in the central region is wider, the luteous chains of the edges are more conspicuous, in *Edw.*; and the lovely roseate flush at the tip of the fore-wings, appears lacking. There is no reference to more than a single original; to constitute a species from one specimen, on variations such as these, is very hazardous, especially when the recognised species is one subject to so much variety. On the whole, I cannot but look upon *Attacus Edwardsii*, until further evidence appear, as a more than doubtful species.

It is right to mention, however, that a very high authority is of a different opinion. Since this note was in type, Mr. F. Moore, of the India Museum, writes me as follows;—"The *Att. Edwardsii* is undoubtedly a distinct species; . . . We have two specimens, male and female, in our Cabinet, from Darjiling. Specimens are also in the British Museum, which are referred to in Walker's Catalogue, Suppl. p. 524. The larva is unknown to me." As Darjiling is 7000 feet above the sea, and has a climate in which rain and snow are abundant in winter, and humidity is constant, it surely would not be difficult to acclimatise this noble form (be it variety or species) in the British Isles. And I cannot but hope that soon living cocoons may be collected by some of the residents there, and transmitted to us.

All this was to be learned afterwards. There it was, clinging to its own vacated cocoon, with horizontal wings; and thence it allowed me to remove it, tenderly, to another foot-hold, on which it remained till noon in my full sight, with no attempt at motion, except an occasional slow and dignified flap of the vast wings. Reluctantly, to preserve its perfect beauty, I now prepared a bed of bruised laurel, in a tight glass vessel, to which I transferred it together with its foot-hold. It stirred no more than before, soon lapsed into perfect quietude, and, as I hope, insensibility, under the powerful narcotic. At the end of seven hours I introduced a drop of Cyan. Pot. Sol. into the thorax by the side; though there was not the slightest sign of life; then pinned and set it, (by means of narrow strips of thin paper across the wings) with perfect ease and success.

Was I not a little hasty in closing the life of my beautiful new-born? I had yet another cocoon in my box, and I had some reason to think it would prove a female. But this was uncertain. If so, it might not evolve for a fortnight, and I might get no marriage. I knew that a single night's liberty would spoil the exquisite beauty of my treasure. And so, having well weighed the *pro* and *con*, I thought it safest to secure the moth for my cabinet in its perfection.

Possibly, had I read the future, my decision might have been different; for two days had not quite elapsed, when my other cocoon produced the imago, and this a female! It had, however, fallen from its hold of the suspended cocoon before I saw it; and contact with the bottom of the cage had prevented its due expansion; for, while the fore wings were perfect, the hind wings were shrunken and shrivelled. It was of a very different variety from the male, being of the two-windowed division, answering to var. γ of the Cat. Br. Mus., p. 1219. The distortion of the wings rendering this example useless for the cabinet, I determined to see how long she would live; and therefore placed her in a bell-glass of fourteen inches diameter, quite open, as she was incapable of flight, the vessel resting in a flower-pot on a table in my study. She survived fifteen days, vigorous most of the time; for a week at least, I think she continued nubile, if there had been a bridegroom at hand. During the day she was motionless, the wings expanded horizontally; but at night-fall she began to flap her great wings with much vigour and incessant pertinacity,

and with the regularity of a machine, of which, indeed, the sound very much reminded me. She laid, in the first week, stuck in groups and strings to the surfaces around, about one hundred and sixty eggs, barren, of course; but which agreed in size, form, and colour, with fertile eggs of the species, which I had just received from the same sources as the cocoons.

EGG.

The egg of *Attacus Atlas* (Plate, fig. *a.*) is not so large as that of *Anth. Pernyi*, and not nearly so large as that of *Anth. Mylitta*, being about 0·08 inch in length, broadly, but irregularly, ovate, granular on the surface,* white, clouded with purple-brown, which tint centres in an irregular mass of intense depth. All this colour is readily washed-off by a few moments' immersion in water, the tinge being communicated to the water; leaving the whole surface of the egg of a delicate greenish-white. The darkest portion of the colour is now seen to reside in a knot of jelly-like membrane†, which, when softened by the immersion in water, can be drawn out to considerable length, but possesses great tenacity, and great elasticity, and adheres to the egg very firmly.

Of fertile eggs I received a dozen from Mr. Watkins, which had been laid on the 23rd July, and a dozen from M. Wailly, laid

* Examined with the Microscope ($\frac{1}{2}$ in. obj. Powell's) by transmitted light, the appearance of the egg-shell is highly curious. The whole substance is semi-opaque, studded equally everywhere with elliptic rings of light, separated by little more than their own area, and inclosing a space absolutely opaque. Each ring is brighter at one side of the circumference than at the other, which suggested the thought that the light was reflected from a raised edge of a cavity. But a revolving of the stage under my eye, made no change of the illuminated side: and a shutting-off of the rays from the window that impinged on the stage did not diminish it. It was therefore transmitted light through the rings; it was the same whether the interior or exterior surface of the egg-shell were next the eye. I can suggest no other explanation of the appearance than this: the entire shell of the egg is perforated, nearly (*not quite*; for the light of the ring is not quite the light of the sky reflected from the stage-mirror, but evidently transmitted through a very thin medium), by a symmetrical series of ring-like cuts, within the area of which the shelly substance rises exteriorly into thickened knobs; whence the deeper opacity; and which produce the delicate granulation. It is probable that here is a provision for the supply of air to the unborn larva. But why should this species need such a provision more than others? In the large egg of *Mylitta* there is nothing like it. When this is examined under like conditions, there is an appearance of irregular pits all over the shell, but there is no transmitted light, no semblance of even approximate perforation.

† The alternately distended and collapsed egg-tube. (See Owen's *Comp. Anat. Invert.* (1855) p. 401; fig. 158.)

just a week later. Curiously, these two batches were hatched on the same day and hour, viz., between 6 and 9 A.M. of the 9th August. Already the little worms manifested the sluggish character common to them through life: they were slow in issuing from the egg; and then crawled little, and slowly.

LARVA.—1st age.

The new-born larva is about 3 lines long in repose, 5 lines when crawling; (fig. b.) General colour black, with a broad band of light grey running down the back for the whole length, and crossed, on the side of each segment by two white lines. The tubercles are tall cylinders of pure white, tallest in front: all of them have white bases, which, uniting laterally, form conspicuous transverse bars of white, one on every segment. From each tubercle proceed several very slender black hairs, of great length. Head glossy black, unspotted; the clypeus grey. Anal region white. Feet black. Prolegs grey.

The habit of the little worms is to sit on the under side of a leaf, almost always in a doubled, or sub-circular position, the head being bent round on either side, toward the tail. I detect no tendency to congregate socially, as *Att. Cynthia*, and *S. Promethea* do when young.

In addition to these, I obtained, at intervals up to 30th August, from Mr. Watkins, between sixty and seventy larvæ, almost all new-born; so that my education has included about eighty-five larvæ in all. My first solicitude was to feed my tender stock. I had observed that, in most cases, the first meal was made of the egg-shell; if the young worm were left for some hours, I found the vacated shell eaten to an extent considerably more than was necessary for exit; even to one-fourth of the whole egg.

Something more nutritive than this was necessary, of course:—but what? M. Braine had fed his protégés on the barberry; Lady Isabella Gilbert hers on apple, peach, plum, “&c.,” but implies that they did best on apple. Mr. Watkins recommended plum. I thought it well to ask the caterpillars themselves which they preferred. This inquiry (as I have done with other species) I put to them in the following manner:

A common flower-pot saucer I filled with an inch of sand, which then I made thoroughly wet, but with no standing surface-water. Into this I stuck one good leaf of each of the following

trees, observing that each was cut with a foot-stalk, and that the edge was entire throughout; careful to handle the leaves as little as possible with my fingers.

Oak	Apple	Berberis Darwinii
Sallow	Beech	„ aquifolium
Hornbeam	Hawthorn	Orange

When the leaves were thus made to stand upright in the firm sand, I tenderly transferred a single worm to each; and then clapped a bell-glass over all.

The first leaf that was nibbled was sallow (*Salix cinerea*); I saw the caterpillar in the act of eating it; for I kept the tiny nursery pretty well under my eye. Then the oak was just notched. The next morning willow and hornbeam were a good deal eaten; and on the day following, still more; oak a little eaten, and afterwards more. The one that had been put on *Berberis Darwinii* I saw on the second day busily and perseveringly gnawing at the central spine of one of the leaf-stipules; when it ceased, I saw with a lens that the hard and sharp point had been gnawed off. But very little more was done to this, and nothing to the other Berberry.

I noticed also the leaves on which they spontaneously chose to rest, as being suggestive:—they congregated, as I carefully noted their places, morning by morning, on oak and willow chiefly; hornbeam and *B. Darwinii* slightly; the rest not at all, nor on poplar, hazel, and birch, leaves of which I subsequently added: apple remained absolutely untouched, and even avoided.

With the exception of one killed by accident, as I was putting down the bell-glass, my first losses occurred on the day that the worms were one week old. On the 16th I saw several, in which the new white head of the second age was dilating the skin, and thrusting-out prominently the present head; a sure token of the approaching moult. But one was lying, not quite lifeless, but moribund, on the damp sand; shrivelled and drying-up. Another was one of those which I have alluded-to as close to the first moult: it also was lying helpless. This one I tried to aid. The minute grains of fine silver-sand were entangled between the tubercles, and in and among the pro-legs. My first effort was to remove these. If it had been able to crawl it would have thrown them off, and left them behind. But it was inert and helpless; and unless I could free the pro-legs it would not cling again, and

so would not be able to get through its moult, not being able to leave the slough behind, as every one knows.

With a lens in one hand, and a fine feather-point wetted in the other, I patiently removed the grains, one by one, avoiding any violence to the tender body. The grains adhering to the under-parts, which would be most injurious, were hardest to be got at. At length, however, I pretty well got rid of all, and placed the little worm on a horizontal leaf. The power of clasping with the pro-legs was, however, so feeble, that the least movement made the worm roll over sidewise; and I feared to leave it thus. Then I bethought myself of the following device: I cut off a flat willow-leaf, and laid it, face-downward, on the sand; the midrib forming a slender projecting ridge. Against this I gently placed the little worm, and had the pleasure of seeing that presently the pro-legs had taken hold of the midrib, while the flat position of the leaf prevented the danger of rolling over. After a quarter of an hour, I perceived that the clasp was firm; and now I could gently lift the leaf, and turn it over in the air, the worm being below, without any relaxation of its hold. My care, however, proved vain; for the worm died where it was put, without being able to accomplish its moult.

Several now died in rapid succession. Wishing to preserve specimens in this age for my cabinet, and their minuteness precluding the hope of inflating the emptied skin, I took one or two of the dead worms as they were, and simply gummed them on a card. A day or two afterwards I perceived one of these bodies very much changed in appearance. Examination by a lens showed that the body was greatly eaten, the fragments lying strewn about; and by its side a loose cocoon, containing a white pellucid larva, about half as long as the little *Atlas* caterpillar. It was certainly lepidopterous; very nimble, much like that of a *Tortrix* or a *Tinea*: it had manifestly been parasitic in the *Atlas*. This contretemps gave me a new glimpse of the perils to which my pets were exposed.

But some passed happily through their first moult. One of these I was so fortunate as to detect at the beginning, and watched to its completion. The process is familiar to all silkworm breeders, and needs not to be recorded anew. What seems noteworthy is, that the tubercles were (not only as they were successively uncovered, but even after the process was completed)

very considerably shorter and more conical than in the former stage. "Parva componere magnis,"—the new-skinned larva reminded me of one of the rays of *Uraster glacialis*, for the cone-shaped tubercles. In a few minutes, however, I was conscious of a change in their form; they were evidently lengthening, by the protrusion of their points, into tall and slender columns. As these grew, insensibly, yet rapidly, the extremities were thrown into angles and curves, which presently were gradually straightened: just as we see the wings of an imago, on emersion from pupa, expanded, not uniformly, but very irregularly, one side at a time, through which the fluids are pouring; while, in the parts immediately near, they are, for the moment, inactive. The result is, to distort, and bend, and crumple, one portion at the expense of another, till this in its turn receives its supply, and presently straightens. So with these crooked tubercles: they were crooked because (minutely slender as they were) the expanding fluids were pouring through a portion of their diameter at a time: but, as I have said, all was equalized in due course, and every tubercle became a very tall and slender cylinder with an expanding base and a slightly clavate summit; and the symmetry of all was perfect, before an hour had passed from the beginning of the moult. So long were they now become (viz. about equal to the diameter of the body) that the impression produced on the unassisted eye was that we looked on a very hairy caterpillar; though, really, there were no hairs, but a few excessively short bristles at the clubbed tip of each tubercle, so minute as to be detected only with high magnifying.

LARVA.—2nd age.

The larva of the second age, a few hours after its moult, may be thus described. Dorsal portion of the body white, mottled on the sides with neutral-tint and cream-colour: a large irregular patch of rust-red on each side on the third and fourth segments, and another of the same hue, still larger, on the ninth, tenth, and eleventh. Ventral surface black. Tubercles white; except the lowest series of the three thoracic, and the penultimate segments, which are dark grey. Head polished chestnut-brown. Prolegs grey.

The next day after the moult, the whole larva is clothed with a white farina, very thick and clogged, similar to that of *Attacus Cynthia*, but much denser. It seems to be exuded only from the

white parts; and not from the grey, black, and red spots: though so copious is the exudation that these coloured patches are considerably encroached-upon by the intrusive substance.*

On the 26th—ten days after the first moult—one of them, by a second moult, passed into the third age. I had observed it at 9 A.M. the new head projecting, waiting its change, and at 11 all was completed. It was on the same leaf as before, just above the sand; where the exuviae, if fallen from the leaf would surely have been lying; but I searched in vain for any trace of it, except a tiny heap of cylinders of white farina, which, I presume, had clothed the old tubercles, and in the middle of these the old skull, or rather skin of the face. I could not avoid the conclusion that the new-changed larva had made a meal of his cast-off clothes. I had many such examples afterwards, and in some instances actually saw a good part of the exuviae devoured; so that this habit may be considered normal.

LARVA.—3rd age (newly moulted).

The larva, in passing into the third age, has not conspicuously changed in colour; but by careful examination I detect differences. The general ground-hue is a semi-pellucid white. The upper and middle series of tubercles, longer and slenderer than before, are white, the lowest series blue-black. The first segment is dark grey, between the white bases of the tubercles; the hinder three segments are minutely speckled with grey. The sides are marked, on each segment, with four diagonal bands, irregular in outline, highest behind, of which the upper two are pale grey tinged with red, the lower two dark grey. The two irregular clouds of rust-red, on each side, are become somewhat wider, and somewhat brighter in hue. The face is polished light bay, the lip dark, the cheeks white. Feet and prolegs dark grey, with deeper bands: the hindmost prolegs have a thickened margin of

* I suspect that this substance is a true Wax, analogous to the *Pe-la* of China, and to the *White-lac* of Madras. (*Kirby and Spence*, Lett. x.) Having allowed a caterpillar to touch the surface of a plate of glass, I examined it by the microscope. I saw many groups of very short and very slender fibres, so arranged as to suggest that they had been exuded in thin laminae of definite width, which then had partly disintegrated (perhaps by contact with the glass) into their component fibrillae; for they manifestly had been parallel, and still had curves and irregularities of form, in common. Having lifted, with care, a minute portion from the tip of a tubercle, by the point of a needle, and transferred it to the glass slide, this appeared much more as irregular thin plates, of which the fibres, though visible, were much less distinct, and less apparently parallel. The substance resembled wax, in its adhesion to the glass, and in the smear it left when moved.

cream-white, which gives a curious appearance of a sort of pedestal-basis to the extremity of the animal. The length when crawling is about nine inches.

On the same day another larva had arrived only at its first moult. The protrusion of the new head had been going on increasingly, so long, and it was manifestly so uneasy, that I thought its moment must be near; and I carefully removed the leaf on which it rested to watch the process. But so long it continued to writhe, inflating its fore-parts, and turning painfully from side to side, that I began to fear its case was hopeless, and that there would be no moult. In such cases, I have before given mechanical aid with success. I now got a fine needle, and under a powerful lens I essayed to abrade the stretched skin behind the black old head. But these touches of mine only made it toss from side to side more violently, and, at length, to loosen its foothold of the midrib of the leaf on which it had clung.

At last I reluctantly gave up hope, and left it lying on the leaf. In half-an-hour, however, I again looked; when, to my surprise and pleasure, I saw that it was more than half-moulted, and looking most promising. There was, however, no attachment of the hind prolegs, and I knew there would be difficulty there. Thus my obstetric aid came in; for with the point of the needle, I held back the pushed-down skin, till the tender hind-parts, even to the last segment and prolegs, were duly drawn out, without the slightest lesion. Then it appeared a quite normal and healthy worm of second age. Yet it never ate more, never grew, never crawled,—but shrivelled and died, like so many more, in four or five days!

A curious instance of self-help occurred under my eye. A larva of second age was evidently annoyed by the fœcal pellet, which having been duly ejected, hung, from some accidental contact at the rectal orifice. I watched. Presently it elevated the hinder parts, and bent them round leftward. Then the head was brought round to the same side, deliberately, and as if with difficulty. At length with a jerk, and a snap, it seized the pellet in its jaws, and threw it out to some distance in front.

But, one by one, they all died. The one that had attained the third age, survived the longest, but succumbed on the last day of August. The larvæ of this species do not in any age either fall, or crawl from their twigs, while healthy, as do some of their

congeners. On two or three occasions I have found the larvæ of *Atlas* on the sand, apparently uninjured, evidently just fallen, and I have replaced them and they have taken hold; but these invariably died without removing farther. A fallen caterpillar is a lost caterpillar, at least in *Attacus Atlas*.

Before matters had quite reached this pass, however, I had procured, from Mr. Watkins, nearly sixty more larvæ, mostly new-born, but a few just entered upon their second age. These came on leaves of plum, on which Mr. Watkins tells me he had fed them exclusively. Yet I thought well to give them a choice of food as before. Accordingly, I had prepared for their reception a six-inch flower-saucer of wet sand, into which I plunged leafy twigs of willow, plum, apple, and Japan quince. The larvæ were sent through the post in tin canisters, in two lots, arriving on the 25th and 30th of August. Some of the first lot were dead, but these were not counted: the second lot were all active. Among the twigs of their nursery I distributed the plum-leaves which sustained the larvæ, carefully handling them by means of pliers, avoiding contact with my fingers. Fearing that I had kept my former in a too confined atmosphere, I decided to give these a freer air, trusting to their proved stationary habit to avoid loss by wandering. Accordingly, the saucer with its little forest, now stocked, I placed in the bottom of a thirteen-inch bell-glass, seated in the mouth of a flower-pot;—covered, indeed, with a piece of white blonde at first, but after a few days allowed to remain quite open in my study-window, the window open day and night at top, facing the S.E.

These conditions, with an exception of place to be after-mentioned, remained unchanged, during the history. The food, also, I by-and-by made wholly sallow; for I found, after a full fortnight's trial (during which I had offered oak, sloe, and pear in addition), that they manifested a very decided preference for sallow, above all,—plum alone maintaining any rivalry with it.

The leafed twigs maintained their succulence well in the damp sand. At intervals of three days I changed the food, and examined the larvæ, keeping a careful register of the number, as distributed in their several ages. My procedure was this: I spread a large sheet of paper on a table, to which I lifted the saucer from the bell, which latter I cleaned out. Then I removed one by one, with pliers very carefully, the old twigs,

laying them tenderly on the paper. A new set of food-twigs had been already prepared; and the surface of the sand in the saucer having been swept of frass, and damped afresh, these fresh twigs were stuck-in, and the saucer re-placed in the bell-glass. Now the effete twigs were subjected to a searching scrutiny; such of the leaves or shoots as supported worms were cut-off with scissors and dropped among the new leaves, examined, and counted, and recorded at the same time.

My little family quickly diminished. Scarcely a single examination passed without revealing some corpses lying flaccid on the sand: but even more were unaccountably missing. This fact, occurring again and again, greatly surprised me. The circumstances made it impossible that any could be overlooked. I examined every leaf with the utmost minuteness, and laid it on paper for re-examination if desirable. The area was a flat surface of wet sand, on which the worms, dead or alive, could not be concealed. The saucer was searched on all sides before it quitted the bell: the clean glass of the bell, when the saucer was removed, would not conceal a cheese-mite. What then could have become of six, and eight, and three worms, absolutely vanished in intervals of three days? I can only suggest that the living larvæ devoured their fellows! I have abundantly proved that the newly moulted eat their own cast skins: and the transition from this to the eating of their dead or dying fellows, is perhaps, not very great. It is noteworthy that none were ever missing after the earliest stages were passed.

Individuals of this family passed into their successive ages at intervals of about seven or eight days; viz., on September 1st, 7th, 16th, 24th. On the 9th, half of the stock were gone, only twenty-five left; on the 17th, when the fourth age was reached, twelve were left; on the 24th, when the fifth age, seven were left. From the first I aspersed the whole nursery four or five times a day, by drawing my finger along a nail-brush dipped in pure water, and depositing an impalpable dew on the whole. I fancied that the worms enjoyed the moisture in so fine a form.

LARVA.—3rd age (advanced).

I have described the larva when newly passed into the third age. After a few days it was much changed in appearance. So wholly and so thickly was it now clothed with farina, that it appeared entirely snow-white, the

orange clouds on the sides seen only as tiny specks; the iron-grey of the lowest tubercles, the feet, and the mottling of the last three segments, all distinguishable only by using a lens; when even the white cheeks are seen to be sprinkled with the same flour. The tubercles of the dorsal and middle rows are very thickly clothed; and by their arrangement give a peculiar aspect to the caterpillar, which it had not before, not even in this stage at first. Those of the prothorax project over the head in close array; those of the metathorax are perpendicular; those of the mesothorax sloping intermediately. Then the abdominal series have a strong backward inclination, and about equally; so that the transition from the thoracic to the abdominal series is abrupt and marked in the *facies*, though really the former are graduated *inter se*. The length now attains about one inch.

LARVA.—4th age (fig. c).

Greenish-white; the skin all studded with minute oval darker specks, which give the impression of translucent cells in the substance. The orange clouds on the sides are nearly obsolete, especially the posterior ones. Last segment azure, with the oval specks dark blue. A rondo-triangular ring of rich pale orange is now conspicuous on the outside of each hindmost proleg. Face wholly pale green; lip and clypeus margined by a black line. Thoracic tubercles shorter and blunter than before; the rest much increased in length, and become soft spines, lying nearly flat, pointing backward and overlapping; lowest row dark iron-grey. Feet and prolegs iron-grey; the latter crossed by a band of greenish white. The farina is again very thick, and is excreted early.

It was now past the middle of September; the weather set in windy and cold; I had not yet begun domestic fires; I therefore removed the whole ménage to an orchid-house, where there was a hot damp atmosphere, probably much like that of the Indian valleys whence the parents came. In one or other of my tropical plant-houses it remained thenceforth, save that, now and then, on a warm sunny day, when I wished to have the larvæ under closer observation, I replaced it for a few hours in my study.

On the 25th of September, several passed into the 5th age. One of these I detected at the very instant of beginning its moult. The first rupture of the old skin was certainly not on the back, but across the breast of the prothorax, extending backwards by a lateral rent on each side. The new face was early freed, and carried the old face on the lip and jaws, to be removed only by rubbing against surrounding objects, when the body was two-thirds denuded. The skin drags upon the dorsal region long

after the sides: the long declined tubercles seem difficult of liberation.

The head appeared very small for the 5th age of so gigantic a moth; and so, indeed, did the whole larva. As the old skin was pushed off in folds, the farina flew about on the currents of air in the room, like the finest flour, and accumulated in little heaps on the leaves below. In general, these tiny heaps of dust are the only remains left where a moult has occurred; for the larva evidently devours its own exuviae. I wished to witness this operation; but, in neither of the moults that had occurred under my eye did the larva, after his labours, take any notice of the exuviae. Nor did this one for a while; but, by-and-by, he turned his head round slowly, and began to munch the exuviae, holding it up bodily in his mouth, till two-thirds were gone, when, the residue falling to the ground, he took no trouble to go down the twig to look for it.

LARVA.—5th age.

The ground-colour is now a pale yellowish green, or green-white; face and lip the same; clypeus edged by a black line, forming a conspicuous triangle; jaws black. Pre-anal plate, and posterior edges of the last prolegs, bright mazarine-blue, studded with the usual skin-cellules (glands?) which are here blue-black. Tubercles tinted with azure at their tips; the lowest series on the first five segments slenderer than the rest, of deep indigo hue. Feet, prolegs, and edges of all the segments, tinted with azure; two black bands surround each proleg, of which one is marginal; hindmost proleg painted with a broad ring of light scarlet, inclosing an azure area, as in the 4th age. Five days after this moult, the larva, when resting contracted to one inch and three-fourths in length, is half an inch in vertical height at the middle, and one-third of an inch in transverse diameter. Crawling it extends to two and a half inches. There is an increased tendency to raise the tubercles from their imbricate recumbent position; especially in crawling, when they are nearly erected. The waxy farina is now considerably diminished; it is still excreted, but in smaller quantity. Hence the forms and dimensions, and even the minute spines, of the tubercles, are now plainly seen; as are also the oval dark spots which crowd the entire skin, which I suppose to be the glands that secrete this flour-like substance.

One of the larvæ of this age dying, I desired to inflate it for the cabinet; and, as a preparatory measure, dropped it into a sat. sol. alum. The body floated half immersed; but, at the instant of touching the water, this waxy farina spread on the

surface to the distance of one-sixth of an inch around the body, forming a pellicle ; and this substance on the larva keeps it from becoming wet, like a duck's feathers.

No farina is excreted till some time after moulting. At first the tubercles are seen to be polished on their surfaces, and to be beset with very fine and short spines, not arranged in whorls. The upper and middle tubercles of the thoracic segments are aborted in this age, leaving only rugose scars.

One cannot fail to remark the resemblance between the larva of *Atlas* and that of *Cynthia*. There is the same whitish-green hue on the upper parts, becoming yellow-green on the lower ; the same tendency to azure at each extremity ; the same soft styli-form tubercles, which also are azure ; the same minute oval glands studding the skin ; and the same clothing of white waxy farina ; which, in both species, becomes conspicuous in the third age, and is obsolescent in the latter part of the fifth. *Atlas* is of more clumsy shape, lacking the elegant fusiform outline of its congener : it has not the yellow extremities, nor the black specks on the sides, of *Cynthia* : but then *Cynthia* has no such ornament as the beautiful pale scarlet ring on each hindmost proleg of *Atlas*. Yet another point of agreement is the smallness of the head in these, compared with the same organ in the 5th age of such larvæ of *Antherææ* as I am familiar with, as *Yama-mai* and *Pernyi*. The propriety of Hübner's separation of *Antheræa* from *Attacus*, which had seemed slight when grounded on the imago only, is much confirmed by the consideration of the previous stages.

At the beginning of October my stock was reduced to five ; but all had been some time in the 5th age, and I began to look for the spinning of cocoons. I had assumed the successive ages of the larvæ, throughout the Lepidoptera, to be limited to five. But, to my astonishment, I saw that the most advanced was preparing for another moult, which, after four days' torpidity, was completed during the night of the 7th. I had carefully recorded all the moults, so that there seemed no possibility of error, though to me the fact appeared without precedent.*

* The variation, however, is not so unprecedented as I at first supposed. Porter (Silk-manufact., p. 120) speaks of a var. of *Bombyx mori*, " which casts its skin only thrice ;" and Capt. Hutton (Trans. Ent. Soc., 3rd ser., p. 299) refers to the same, which, however (p. 311), he considers a distinct species. Both refer to Count Dandolo, as their authority for the fact. M. Bavier (La Sericicult. au Japon.,

LARVA.—6th age. (Fig. d.)

The ground-colour is now a delicate, soft pea-green, which towards the back becomes more and more white, owing to an exceedingly fine coating of the farina. The pre-anal shield is flat, thick, and horizontally extended; it is tinged with blue. All the tubercles have the form of short, soft, slender spines, beset very sparsely with minute spiculæ. These organs are of a lively azure hue, which is concealed to some extent by a coarser exudation of the farina, which clogs irregularly about them, like damp flour. The two upper tubercles on the eleventh segment are, as usual, united into one, thick, and medially placed. The middle one on the same segment is reduced to a mere wart: the lowest is normal. The prothoracic tubercles are azure, as all the rest, but are tipped with shining blue-black; the upper and middle meso- and metathoracic tubercles appear as if cut off just above their bases, each leaving a sort of wrinkled scar, of azure hue. Feet azure; the terminal joint polished black, whence a black line runs up in front of the higher joints. Prolegs azure, crossed by two bands of polished black, and terminated by a soft margin of pellucid purplish green, which carries the clinging hooks: the space between the two black bands is azure, and this space is set, at the lower margin, with a row of fine short white bristles, curving downward. The hindmost bear, each on its upper and outer portion, the usual triangular mark, which in this case is sub-quadrantic, wide, and of a lovely light scarlet, or miniate, hue, the inclosed area being azure.

The spiracles are rather large, ovate, and of the same azure hue. The pro-thoracic segment has its front edge now quite smooth; whereas in the previous ages it carried four protuberant teeth, the progressive obliteration of which well marks the successive ages; for, so late as the 3rd age, these are long (as long as the tubercles), flexible and tentaculoid; in the 4th, much reduced, but still tooth-like; in the 5th, mere blue knobs; and in the 6th, wholly obliterated, or recognisable only as a slight transverse ridge just behind the collar-edge. The head is of the common light-green hue,

p. 8) says, "Les vers japonais traversent les quatre mues, à l'exception d'une race . . . qui file le cocon au bout de la troisième mue."

Burmeister (Man. Entom.; Shuckard's transl., p. 431) observes that the caterpillars of some of the larger moths moult very frequently: "for instance, *Arctia villica*, from five to eight times; *A. dominula*, nine times; and *A. caja* ten times."

In the case of my *Atlas* larvæ, as I had but one that attained this maturity, I might have supposed it accidental and abnormal. But a gentleman, who also has essayed the rearing of this species from larvæ of the same brood as my own,—Mr. Thomas Edmonds, of Bedford Row,—confirms my experience. He observes, "I feel sure that mine have moulted five times, and are in their 6th age, as yours are." Mr. Edmonds mentions that he has reared two broods of *Samia Promethea*, of both of which the larvæ moulted three times only. On the contrary, my own experience of *Promethea* gives them the ordinary number of four moults.

polished, the clypeus marked by a triangular black line; the ocular patch black; lip and palpi azure; jaws black. A streak of shining black, on each cheek, is visible when the head is protruded, as in eating or crawling.

The whole skin of the upper parts, down to the line of the spiracles, is studded with those curious specks, which I suppose to be glands, more or less round, dark pellucid olive in hue, most conspicuous on the thoracic region, where they are occasionally confluent. Their surface is everywhere level with the skin, save around the edge of the pre-anal shield, where they become tiny conical warts, of a blue-black hue. The tubercles of the abdominal segments, in repose, lie flat, pointing backward and overlapping; so as, in their aggregate, to convey the impression of four bluish-white thick keels, or longitudinal ridges, along the body. In the extension of the body for crawling, they are slightly elevated, and then reveal their true character.

The four caterpillars remaining of the fifth age, now suddenly died; all of a disease of the bowels, the fæces becoming soft, clogging the margin of the rectum, and ultimately changing to a brown fluid. The solitary survivor of so numerous a family continued a fortnight longer, apparently prospering, and attaining the size and beauty which I have sought to represent in the plate, fig. *d.*; after a time, however, eating less and less, and diminishing in size. My willow tree was fast denuding; the leaves grew less attractive, less nutritive,—perhaps even unwholesome. At length, on the 20th of October, I was dismayed by observing the familiar symptoms of incipient diarrhœa, in the softened clogging fæces. I had just been reading Dr. Le Doux's valuable Memoir (Bull. Soc. Acclim., Aug. 1878) “De l'influence de Quinquina sur les Vers à soie.” I immediately applied Quinine to my little patient, bedewing it, *and its food-leaves*, with a very weak solution. I was gratified by seeing that it presently began to eat; that it ate freely, necessarily receiving a minute amount of the drug into the stomach, as well as into the skin; that the fæces were discharged in pellets, and became firmer. The ominous symptoms I have often seen in other species, as well as this; and I have invariably found that they have run to a fatal termination in twenty-four hours. My *Atlas*, indeed, died; but he survived these symptoms seven days, during which they certainly did not grow worse, but better; so that, *qu. val.*, my experience confirms the value of quinine in this terrible disease of our silkworms. On the last day of its life, my caterpillar both ate and crawled on his plant; but, on the morning of the 27th of October, I found him fallen to

the ground, much shrunken, a drop of brown fluid oozing from *the mouth*; but nothing abnormal about the anus. The medicine surely arrested this; it did not preserve life, but I think it prolonged it.

COCOON AND PUPA.

My cultural experiment fell short of the desired result; but, as I began it with imported living cocoons, its cycle is almost complete. The Cocoon of *Atlas* (fig. *f.*) is often rudely bag-shaped, but sometimes long spindle-shaped, like that of *Cynthia*, running up above, however, into a slender cord, which embraces the footstalk of a leaf, and below dilating into a thin lamina of silk, which is spread over the surface of a leaf. Its form is in some measure determined by the concavity of several leaves drawn together, to the internal surfaces of which the Cocoon adheres. When it is wholly spun, the leaves can be readily stripped away, leaving a permanent impression of their form and neurulation on the silk.

The Cocoon, omitting the cord and the lamina at the extremities, is from two to three inches in length, and about one inch in greatest width. Its colour is a light umber, or drab; its surface (independently of the impress of leaves) roughly granular, scarcely at all silky or floccose, except at the mouth; its substance thin, parchmenty, very firm; the interior very smooth, and even sub-glossy. The upper extremity forms a natural orifice for the exit of the moth, made by the convergence of a great number of silk-fibres, which are left ungummed, and are thus soft and flossy; the gummed stiff silk passing up on one side, and contracting into the cord. Thus the cocoon is not *closed*, like those of *Bombyx mori*, of *Telea*, of the *Antherææ*; but open, like those of *A. Cynthia*, of the *Samia*, of the *Saturnia*.* As a result of this structure, the exit of the imago leaves no disturbance behind, no wetness, no disarrangement of these soft fibres, such as is the case with *Yama-mai*, *Pernyi*, and *Mylitta*.

The Pupa (fig. *e*) is not much longer than that of *Yama*; but it is much more bulky. My specimens measure as follows:—

	Male.	Female.
Length - - - - -	1·20 inch.	1·35 inch.
Breadth (from side to side) -	0·65 „	0·72 „
Depth (from back to front) -	0·70 „	0·82 „

In both sexes the wing-covers are very great; the superior are falcate in both; the inferior notably project. In the male the antennæ-covers are 0·35 inch broad; the pectination distinctly marked. The abdomen terminates in a short papilliform tail. The general hue is a bright chestnut, darker on the abdomen.

Looking back on the eighty larvæ which had been under my unremitting and most watchful care since the beginning of

* Viz., of *S. pyri*, and *S. spini*; and also of our own *S. carpini*,—save that the second converging dome-fibres of the last-named seem peculiar to this species.

August, *with this result*, I strive to discover the cause of failure. It is not invariable. I know of only two English attempts besides my own. Mr. Edmonds began with twenty-four ova, all of which hatched, and almost all did well till the 6th age, when all died of dysentery, about the same time as my own. On the other hand, Captain Lendy, of Surbiton, beginning with twenty-four ova (of the same lot), has obtained fifteen good cocoons. This gentleman's experience is, then, of great value.

The lateness of the season at which the larvæ appear is, doubtless, the main difficulty: the increasing cold protracting the larval existence, to the weakening and exhausting of the animal. Lady Gilbert's worms passed into cocoon within less than a month from the hatching: my own lingered for more than two months and a half; Mr. Edmonds's for three months. Captain Lendy informs me that he placed his new-born larvæ in a plant-stove, in which the temperature ranged from 65° at night to 85° or even 90° by day; *and he obtained cocoons within a month from hatching.*

This points, as I judge, not to the use of artificial heat, as essential to success in England, but to a summer, rather than an autumn life. I have just obtained some imported cocoons, which I shall winter in a warm room, in hope to evolve imagines in spring; and so get ova in May, and larvæ in June, if possible,

I do not think the kind of food-plant is of vital importance. Captain Lendy is confident that the common berberry is the only proper food. Mr. Edmonds fed his with plum. Lady Gilbert extols apple. Mine chose sallow for themselves. All the *Saturniadæ* seem to be very polyphagous. Whether the frequent dewing of the worms with fine spray was useful or hurtful I am not sure. I recollected the excessively humid atmosphere of the mountain-forests of India; and, considering that in my room they never felt a drop of rain or dew, it seemed that occasional aspersion was an approach to natural conditions, which might be grateful. Captain Lendy never aspersed his; but then his plant-house was doubtless damp. If I obtain sufficient larvæ in the coming summer, I purpose to attempt culture in the open air, on the common berberry, and other trees, surrounding a large branch on which the larvæ are placed, with blonde or gauze, to protect them from birds.

It may not be wholly irrelevant to add that I have already in my possession a considerable number of living pupæ in cocoon,

of two other noble Indian species, viz., *Caligula Simla*, and *Antheræa Roylei*, neither of which has, so far as I know, been yet reared in Europe. The food of neither is known; but the cocoons of the latter, which are of large dimensions, are closely enveloped in leathery leaves, which Sir Joseph D. Hooker assures me are those of "*Quercus incana*, a tree which grows along almost the whole length of the Himalaya, at elevations of 5000 to 8000 feet, from the Indus to Nepâl. It does not, however, extend eastwards into Sikkim or Bhotan; nor does it descend into the plains." I gladly publish this valuable information from such a source, because others will be raising *Roylei* as well as I; and, judging from experience of other oak-eating species, we may now very confidently present to the larvæ the leaves of the English and Turkey oaks.

Whether the silk of these species and of *Atlas* will ever be of any commercial value in this country I do not know. My interest in them is that of a naturalist, rather than that of an economist; and in that capacity I venture to present these notes to the readers of the 'Entomologist.'

POSTSCRIPT.—Since the preceding article was in type, I have seen a valuable Memoir, by Dr. Chavannes, of Lausanne, "On Silk-spinning *Saturniæ* desirable to be introduced into France" ('Bullet. de la Soc. d'Acclim.,' July, 1855). In a short paragraph on *Atlas*, he says:—"The silk is stronger and thicker than that of *Aurota* [which he had just praised, as far exceeding, in these respects, that of *B. mori*]; and could probably be wound to a single thread (à un seul brin), like that of *Mylitta*. Though less rich, the cocoon of *Atlas* would yield almost as much silk as this last: The worm is the *Fagara* of China, where it has been long cultivated. . . . *Mylitta*, *Atlas*, and *Mimosa* commend themselves by the great quantity of silk which they furnish."

I hasten also to correct an error, in the earlier part of this Memoir (p. 29), by information just received from Mr. Watkins. He says:—"In January, 1876, I received about twenty cocoons each of *Attacus Atlas* and *Actias Selene*. Two of these were purchased by Leonard Marshall, Esq., who obtained, in March, 1876, a female *Atlas* moth, which is now in his possession. During the same spring I bred the remainder; but only one pair was evolved at one time, which yielded eggs that were never hatched."



